UPPER YARD INTERIM ACTION
AS-BUILT REPORT

UNOCAL EDMONDS TERMINAL

EDMONDS, WA

VOLUME I

Prepared for

Unocal Corporation

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Upper Yard Interim Action As-built Report
Unocal Edmonds Terminal
Edmonds, Washington

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CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

TABLES AND FIGURES

Following Report

Tables

TABLES AND FIGURES (Continued)

Figures

TABLES AND FIGURES (Continued)

TABLES AND FIGURES (Continued)

Drawings

ACRONYMS AND ABBREVIATIONS

AL	action level
Bcy	banked cubic yards
Bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylenes
CMP	compliance monitoring plan
CUL	cleanup level
Cy	cubic yards
DRO	TPH as diesel range organics
EPH	extractable petroleum hydrocarbons
FS	feasibility study
GRO	TPH as gasoline range organics
HO	TPH as heavy oil range organics
mg/kg	milligram per kilogram
MLLW	mean lower low water
MTCA	Model Toxics Control Act
MW	monitoring well
PAHs	polycyclic aromatic hydrocarbons
POC	point of compliance
RI	remedial investigation
SAP	sampling and analysis plan
SEPA	State Environmental Policy Act
TP	test pit
TPH	total petroleum hydrocarbons
VPH	volatile petroleum hydrocarbons
WAC	Washington Administrative Code

1 INTRODUCTION

1.1 Purpose

This report summarizes and documents an interim remedial action performed at the Unocal Edmonds Terminal, Edmonds, Washington, from July 2002 to May 2003. The interim action was performed consistent with the Model Toxics Control Act (MTCA) regulations of WAC 173-340-430, and was conducted to meet final cleanup standards for the upper yard portion of the Unocal Edmonds Terminal.

1.2 Background

Union Oil Company of California, dba Unocal, entered into Agreed Order No. DE 92TC-N328 with the Washington Department of Ecology (Ecology) to conduct environmental investigations at the Unocal Edmonds Terminal (Terminal) located at 11720 Unoco Road in Edmonds, Washington (Figure 1-1). The scope of the Agreed Order, issued pursuant to MTCA, included a remedial investigation (RI) and a feasibility study (FS). The RI was performed between October 1994 and August 1996 and reported to Ecology [EMCON, 1996a and 1998; and Maul Foster & Alongi, Inc. (MFA), 2001a]. A preliminary FS was performed in 1996 and reported to Ecology (EMCON, 1996b). An updated and expanded FS will be conducted and reported to Ecology in 2003.

Unocal performed an interim remedial action in the upper yard of the Terminal to reduce the potential threats to human health or the environmental posed by exposing contaminated surface and near surface soil after the 2001 dismantling and removal of the aboveground fuel storage tanks and lines, and to return that portion of the site to productive use by meeting final cleanup standards. Specifically, petroleum-contaminated soil and metals-contaminated surface soil (containing sand blast grit and paint chips) were removed from the upper yard and transported off site for treatment and disposal. During this work, Unocal also removed an asphalt/polyurethane coating material from the soil surface in several areas of the upper yard. This material had been used for erosion control.

As required by WAC 173-340-430, an Interim Action Report was prepared before performing the interim remedial action (MFA, 2001b). The report (a work plan) was issued for public comment and was reviewed by Ecology. A State Environmental Policy Act (SEPA) checklist was prepared in conjunction with the work plan; copies of the SEPA checklist and the Determination of Nonsignificance are provided in the Interim Action Report. Ecology approval was required prior to initiating the upper yard interim action. Approval was granted by letter dated July 31, 2001.

1.3 Public Participation

The following public participation activities were performed: The Draft Interim Action Report was placed at four public repositories (Ecology's Northwest Regional Office, Edmonds Public Library, Mountlake Terrace Public Library, Lynnwood Public Library); a 30-day public comment period was held by Ecology for review of the draft document (June 11 through July 11, 2001); a public meeting was held in Edmonds on June 20, 2001; and notification letters were mailed to all property owners within a ½-mile radius of the Terminal on July 11, 2001 and July 15, 2002.

1.4 Report Organization

This report is organized as follows:

- Section 2 provides a description of the Terminal and supplemental work performed in conjunction with the remedial work;
- Section 3 describes the interim remedial action performed in the upper yard, including soil sampling and analysis procedures;
- A summary of the volumes of soil removed during the remedial work is provided in Section 4;
- Section 5 reports the soil sampling results and the determination of compliance with MTCA Method B cleanup standards;
- A summary of the remedial action is provided in Section 6; and
- The professional engineer's statement is provided in Section 7.

2 SITE DESCRIPTION AND ADDITIONAL SITE WORK

2.1 Site Description

The site comprises approximately 47 acres of land on and adjacent to the northern slope of a hillside, and lies within approximately 1,000 feet of the Puget Sound shoreline. At its nearest point (southwest corner of the site), the site boundary is approximately 160 feet from the Puget Sound shoreline. The site has two distinct areas, the upper yard (tank farm) area and the lower yard area (Figure 2-1).

The lower yard is approximately 22 acres in area, lying east of the Burlington Northern Santa Fe Railroad (BNSFRR) right-of-way, south of Union Oil Marsh, west of the Deer Creek Salmon Hatchery, and north of the upper yard. The lower yard elevation ranges from approximately 10 to 25 feet above the mean lower low water datum (MLLW). The lower yard consists of office buildings, two former truck bading racks, two underground (former vapor recovery) tanks, two underground vaults, two storm water detention basins, and an oil/water separator. Previous operations also included an air-blown asphalt plant, an asphalt packaging warehouse, and a railcar loading/unloading facility.

The upper yard is approximately 25 acres in area, located immediately south of the lower yard. Upper yard elevations range from approximately 25 to 150 feet MLLW. The upper yard consists of several former tank basins.

UNOCAL operated the Terminal from 1923 to 1991. Fuel was brought to the Terminal on ships, pumped to the storage tanks in the upper yard, and loaded from the tanks into railcars and trucks for delivery to customers. An asphalt plant operated on the site from 1953 to the late 1970s. Detailed descriptions of the Terminal facilities and historic activities are presented in the Background History Report (EMCON, 1994). The facility is currently used only for office purposes. All of the tanks and lines in the upper yard were cleaned and removed from the site in 2001.

2.2 Additional Site Work

2.2.1 Cultural Resources Survey

Prior to the interim action, a cultural resource survey was performed in March 2002 in the vegetated areas of the upper yard by Cascadia Archeology (Cascadia Archaeology, 2002). Survey methods included pedestrian transects combined with shovel probes. No potentially significant cultural material was found within the project area and no prehistoric cultural resources were encountered. A copy of the survey report is provided in Appendix A.

2.2.2 Additional Soil Borings and Test Pits

In June 2002, Cascade Drilling, Inc., drilled 14 soil borings (SB-236 through SB-249) in the upper yard. The borings were advanced to collect additional subsurface soil quality data at select locations in the upper yard. The borings were advanced to depths between 15 and 80 feet below ground surface (bgs). The work was performed following procedures specified in the site Sampling and Analysis Plan (SAP) (MFA, 2001c). Soil boring logs are provided in Appendix B.

During the interim action soil excavation work, which commenced in the western third of the upper yard, the petroleum hydrocarbon concentrations in the subsurface were highly variable. Total petroleum hydrocarbon (TPH) concentrations from the RI and post-RI sampling routinely varied from what was encountered in the excavations. Therefore, before commencing the excavation of TPH-contaminated soil in the middle and eastern thirds of the upper yard, numerous test pits were excavated in the remaining basins to refine the impacted soil volume estimates. The information obtained from the test pits was also used for soil management planning (e.g., loading, internal haul routes), contractor labor and equipment re-assessment, and scheduling. In December 2002, test pits were excavated in basins 2909, 2910, 2911, 2912, 2914, 3392/3393/33944, 4120, F410, and the area between basins 2911 and 2913 ("TPH Area K"). Test pits were also excavated in basin 263 (January 2003), at locations below basin 2605 (February 2003), and in basin 3716/3717 (March and April 2003).

The soil sample analytical results from the 14 soil borings and the test pits are displayed on Drawing B-1, TPH in Upper Yard, provided in Appendix B.

2.2.3 Monitoring Well Abandonment

Prior to excavation in the upper yard, Cascade Drilling, Inc. (Cascade) of Woodinville, Washington, abandoned the monitoring wells and piezometers (MW-5U, MW-10U, MW-11U, HA-5, HA-12, P-201S, P-201I, P-201D, P-203S, P-203I, and P-203D; Figure 2-1) located in the planned areas of excavation. These monitoring wells and piezometers were abandoned on June 28, 2002, pursuant to procedures described in Minimum Standards for Construction and Maintenance of Wells (WAC 173-160-310). Nested piezometers P-202S, P-202I, and P-202D, located south of basin 3392/3393/3394, were covered by sloughed/eroded soil several years ago and thus were not accessible during the abandonment activities in June 2002. The tops of the piezometers were inadvertently excavated when soil was removed from the area during the remedial work. A 1-inch-diameter casing of one of the piezometers was located and was abandoned by Cascade on April 29, 2003, by using bentonite grout tremmied to the bottom of the casing. The other two casings were not found, but the exposed portion of the nested piezometer area was completely filled with bentonite.

Following completion of excavation activities in the upper yard, Cascade abandoned monitoring wells MW-201, MW-202, MW-204, and MW-7U (Figure 2-1). The work was performed pursuant to procedures described in WAC 173-160-310. Currently, no monitoring wells or piezometers are present in the upper yard. The monitoring wells located near the eastern side road to the upper yard and the garage (MW-203 and MW-13U, respectively) were not abandoned. These wells were formerly considered to be upper yard wells but are not included in the currently designated area of the upper yard.

3 UPPER YARD INTERIM ACTION

3.1 Scope of Work

The scope of the upper yard interim action was based on the Interim Action Report (MFA, 2001b), the Compliance Monitoring Plan (CMP) (MFA, 2002a) and the Technical Specifications (MFA, 2002b). The report was approved by Ecology in a letter dated July 31, 2001 (Ecology, 2001). The Technical Specifications were reviewed and comments were provided by Ecology on June 6, 2002 (Ecology, 2002). The work was performed primarily between July 29, 2002 and May 31, 2003. The work was performed to meet the final MTCA Method B cleanup standards developed for the upper yard.

The remedial action consisted of the removal of petroleum-contaminated soil and metals-impacted surface soil (containing sand blast grit and paint chips). Additionally, Unocal removed an asphalt/polyurethane coating material from the surface of large areas of the upper yard. This material had been used for erosion control. To treat high suspended solids concentrations in storm water runoff from the upper yard during the excavation activities, Unocal installed additional storm water collection and separation equipment in the lower yard.

3.2 Cleanup Levels and Action Levels

MTCA Method B cleanup levels (CULs) were developed for the upper yard during the preparation of the CMP. Unocal also identified action levels (ALs) for TPH-impacted soil in the 0- to 15-foot bgs horizon. The action levels were used for purposes of making more conservative field decisions during soil excavation, such that average post-remedial TPH concentrations would be lower than Method B CULs. Method B CULs were used for the MTCA-specified compliance demonstration.

The action levels and Method B CULs, and associated soil horizon, are listed for each contaminant in the table on the following page.

Contaminant	Unocal Action Level (mg/kg)	Unocal Action Level (mg/kg)	Method B CUL (mg/kg)
	0 to 10 feet bgs	**10 to 15 feet**	**0 to 15 feet bgs**
TPH as GRO	100	--	200
TPH as DRO	200	--	460
TPH as HO	200	--	--
TPH (all ranges)	500	1,000	2,959
Arsenic	--	--	20
-- Not applicable. GRO = gasoline range organics. DRO = diesel range organics HO = heavy oil range organics.			

The derivation of the CULs is described in detail in the CMP, and is not repeated in this report.

3.3 Point of Compliance

The point of compliance (POC) is the point or points where the soil CULs must be attained. Per the CMP, POCs were specified for the following pathways:

- Direct human contact with soil
- Protection of groundwater
- Protection of terrestrial ecological receptors

For direct human contact with soil and for protection of terrestrial ecological receptors, the POC is established in soils throughout the site from ground surface to 15 feet bgs (WAC 173-340-740(6)(d) and –7490(4)(b))[1]. This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of future site development activities, resulting in exposure to human and ecological receptors. For protection of groundwater, the POC is established in soils throughout the site from the ground surface to the water table (WAC 173-340-740(6)(b)).

[1] For this interim action, "throughout the site" means throughout soil in the upper yard. Figure 2-1 shows the boundary of the upper yard.

3.4 Contractors

Wyser Construction, Inc. (Wyser) of Bothell, Washington, conducted the excavation, transportation, backfilling, grading, drainage system work, and utilities-related work. A Wyser subcontractor, IRS Environmental, removed the asbestos-containing piping that was encountered in a limited number of the basins. The piping was disposed at the Rabanco Regional Landfill in Roosevelt, Washington. Triad Associates, Inc., of Kirkland, Washington, performed pre- and post-excavation surveys. Laboratory analyses were performed by North Creek Analytical, Inc., of Bothell, Washington, and Columbia Analytical Services, Inc., of Kelso, Washington. Construction monitoring was performed by MFA. Thermal treatment of petroleum-contaminated soil and recycling of the asphalt/polyurethane coating were performed by Rinker Materials. Metals-contaminated soil and limited volumes of petroleum-contaminated soil were disposed at the Olympic View Sanitary Landfill located in Port Orchard, Washington.

The daily reports prepared by Wyser to document work performance have been submitted to Ecology under separate cover.

3.5 Mobilization

Air monitoring procedures were established and air monitoring was performed by MFA for the purposes of monitoring dust and petroleum odors, as necessary, during the excavation work. A sedimentation and erosion control plan was prepared by MFA.

3.6 Soil Excavation

3.6.1 Excavation Extents

TPH Excavation. Soil was excavated by using conventional excavation equipment. Excavations extended vertically and laterally until TPH-contaminated soil was not present in the excavation floor or sidewalls based on field screening, progress sampling, and/or performance sampling.

When additional soil removal was necessary as a result of a failing performance sample, soil was typically removed over an area from the sample location to half the lateral distance to each of the nearest clean sample locations. The depth (and in some cases the lateral extent) of additional soil removed was determined on a case-by-case basis based on the concentration of the failing sample. The minimum excavation depth was 0.5 feet below the original basin grade in basin 3716/3717, and the maximum excavation depth was approximately 23 feet below the original basin grade in basin 1749. Following the additional soil removal, a set of "secondary" performance samples were collected and analyzed, per the CMP. These secondary samples were located to demonstrate that the lateral and vertical extent of the overexcavation was sufficient.

When a secondary sample result/location exceeded the CUL, the location of the failing sample was overexcavated, and the *entire* grid was re-sampled (not just the location of the failing sample). The new grid was offset from the original grid by randomly selecting a point of the compass and off-setting the grid five feet in the selected direction. The compliance evaluation was then conducted on the new data set.

Prior to backfilling, the contractor completed a survey of the vertical and horizontal extent of all TPH-impacted-soil excavations greater than 2 feet in depth. The survey was completed by a surveyor licensed in the State of Washington. The post-excavation survey drawing is provided in Appendix C.

Metals Excavation. Surface soil was excavated by using conventional excavation equipment. Metals-contaminated soil was excavated from the ground surface to approximately 0.5 to 1 foot bgs. Additional soil was removed if field screening, progress sampling, and/or performance (compliance) sampling indicated that contaminated soil was still present. In two areas of the upper yard (Metals Area 1B and 4), a vacuum truck was used to remove sandblast grit that had accumulated around piping, pipe supports, and a staircase.

When additional soil removal was necessary as a result of a failing performance sample, the excavation was typically extended an additional 0.5 feet in depth, over an area from the sample location to approximately half the lateral distance to each of the nearest clean sample locations.

Asphalt/Polyurethane Coating Excavation. The coating material was removed by using conventional excavation equipment. The coating and underlying soil was typically removed to depths of approximately 0.5 to 1 foot below the coating surface.

3.6.2 Sequence of Work

Excavation work began on July 29, 2002, and was completed on May 15, 2003. The work was sequenced such that the majority of the metals-contaminated surface soil was removed before removal of TPH-contaminated soil. Excavation of TPH-contaminated soil commenced in the western-most third of the upper yard and moved to the east. Basins 3716/3717 and 263 were used by the contractor as primary soil stockpiling/staging areas. The storm water drainage lines in the excavation areas were removed on a basin-by-basin basis during construction work. TPH excavations were surveyed after receipt of the final sampling results for the excavation area. Backfilling, grading and compaction was also sequenced, with this phase of work commencing in January 2003 and continuing through May 2003. Storm water drainage lines and structures were replaced in a phased manner.

3.7 Sampling and Analysis

3.7.1 General

Soil samples were collected and analyzed using the procedures identified in the site SAP. Performance monitoring (i.e., sampling to confirm that CULs were attained) was performed consistent with the CMP.

Field screening and progress sampling were performed to direct field work during soil excavation. Field screening consisted of the use of TPH field indicators, including soil staining, odors, vapors, and sheen testing, to subjectively identify the presence or absence of TPH in screened soil. Progress sampling consisted of collecting biased samples from the floors and/or sidewalls of the soil removal areas during active excavation. Progress samples were submitted to the laboratory for analysis and the results were compared to Unocal ALs to evaluate whether additional soil removal in an excavation area was necessary. Progress samples were interim, biased samples. The progress sample results were not used to evaluate compliance with CULs.

After excavation, performance samples were collected to confirm that metals and TPH concentrations at the extent of the excavations met CULs. Samples typically were collected on 20-foot centers for TPH, and 40-foot centers for metals, in accordance with the procedures described in the CMP. In most basins, one grid was established for both TPH and metals (arsenic) sampling.

A total of over 1,200 TPH and arsenic progress samples were collected during the excavations. Over 800 TPH performance samples and 500 arsenic performance samples were collected to demonstrate compliance with the CULs. The TPH excavation areas are shown on Drawing No. 1 and the metals excavation areas are shown on Drawing No. 2. These drawings also show all of the performance sample locations.

3.7.2 TPH Excavation Areas

Per the CMP, soil sampling grid spacing (distance between nodes) was set at 20 feet. If a node fell outside the final excavation area and was located within 5 feet of the excavation, then the sampling location was moved to the excavation edge nearest the node. For excavation areas that were too small to accommodate a grid with 20-foot grid spacing, a smaller grid was used to generate a minimum of 5 samples.

Samples were collected at each TPH grid node in the excavation areas. The sampling interval was the soil surface to approximately 0.5 feet below the soil surface. As noted above, samples were collected from the base of each excavation. Depending on the excavation configuration, samples collected from the base of an excavation were located at several different elevations. In excavations greater than 4 feet deep, sidewall performance samples were collected. Noteworthy information about specific areas is provided below.

TPH Area E. Soil excavation was not performed as planned at TPH Area E, as field screening and progress sampling performed in three test trenches excavated at this location indicated that TPH was not present at concentrations above or near CULs and ALs.

Three trenches were excavated at and around the former test pit that defined Area E (UYTP-7), located north of basin 1749 (Drawing No. 1). The first (preliminary) trench was approximately 20 feet long and 4 feet deep, trending perpendicular (east-west) to the planned excavation area. No field indications of petroleum were noted and the trench was backfilled. Another trench was excavated ("Trench 1") trending north-south and located in the planned excavation area. This trench was approximately 15 feet long, 6 feet wide, and 8 feet deep. No field indications of petroleum were noted in this trench. "Trench 2" (trending east-west) was excavated south (uphill) of Trench 1 and trended perpendicularly (east-west) across the planned excavation area. This trench was approximately 30 feet long, 6 feet wide, and 10 feet deep. No field indications of petroleum were noted in this trench. A progress sample was collected from both Trench 1 and Trench 2, and the excavated soil was placed back in the trenches. TPH was detected in the progress sample from Trench 1; however, the concentrations were well below TPH CULs. TPH was not detected in the progress sample collected from Trench 2.

Additionally, two test pits (Z-TP-5 and Z-TP-6) were excavated near Area E/UYTP-7 to evaluate the soil quality north-northwest of the basin 2602/2603/2604 (Area F) berm. These test pits were located between approximately 10 and 30 feet from Trench 1 and Trench 2, respectively. No odors or visual evidence of petroleum contamination were noted in either test pit. One progress sample was collected from each test pit and the excavated soil was placed back in the test pits. The progress samples did not contain detectable TPH.

Based on field screening and progress sampling in the trenches and test pits, no additional work was performed in Area E.

TPH Area F. In basin 2602/2603/2604, petroleum contamination was found to extend across the basin. As such, the entire basin was considered TPH Area F (i.e., planned Areas F and G were combined into one basin-wide sampling grid and named Area F).

SS-204. Per the CMP, one soil sample was collected from the location of RI sample SS-204, located west of former Tank 1749 (Drawing No. 1). The sample results from this RI sampling location exceeded TPH CULs. Based on its location (in an asphalt coating area and not associated with a pipeline or tank basin), the observed concentrations were suspected to be due to asphalt, rather than petroleum spills or leaks. Per the CMP, a sampling grid was not established around this point. After the asphalt coating was removed, location SS-204 was surveyed in and a soil sample was collected from the location and submitted for analysis of TPH as gasoline range organics (GRO), diesel range organics (DRO), and heavy oil range organics (HO), for benzene, toluene, ethylbenzene and xylenes (BTEX), and for polycyclic aromatic hydrocarbons (PAHs).

SS-201, SS-202, SS-205, SS-209, SS-212, SS-213. Certain metals sampling areas were also associated with surficial TPH contamination, as shown by samples collected during the RI. Per the CMP, the RI samples collected from certain metals excavation and sampling areas were also analyzed for GRO, DRO, HO, BTEX, and PAHs. Locations SS-202 and SS-209 in Metals Area 2 and location SS-213 in Metals Area 6C were analyzed for GRO, DRO, HO, BTEX, and PAHs. The sample from location SS-213 was also analyzed for volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH). Following the removal of metals-contaminated soil, these RI sample locations were surveyed in and new samples were collected for TPH-related analyses.

The CMP also called for TPH-related analyses at locations SS-201, SS-205 and SS-212. However, these location-specific samples were not collected because they were located in areas extensively over-excavated (and subsequently gridded and sampled) for TPH (SS-201 and SS-212 in TPH Area U and SS-205 in TPH Area F) (Drawing No. 1).

New TPH Area SWL. Significant soil contamination was found in the drainage swale located between Area F (basin 2602/2603/2604) and Area I (basin 2913). Contamination appeared to have migrated from basin 2602/2603/2604 (through the northeast berm) as well as migrated down this drainage swale. Based on the contamination pattern and location, a new TPH Area "SWL" was established.

New TPH Areas ASWL1 and ASWL2. Given the findings at the bottom of the drainage swale (TPH Area SWL), where the soil around the catch basins and storm drain lines was contaminated with petroleum hydrocarbons, it was anticipated that the soil along the rest of the storm drain line may be similarly contaminated. An asphalt swale was constructed some time ago to collect and route surface water along a stretch of the upper yard, just above the tree line on the north side of the upper yard. During the excavation of TPH Area K (a drainage swale located between basins 2913 and 3392/3393/3394), contamination was found to extend to and along the asphalt swale as it traversed the bottom of Area K. New TPH Area "ASWL1" (for asphalt swale 1) and Area "ASWL2" (for asphalt swale 2) were established. TPH Area ASWL1 stretched from catch basin U17 to catch basin U19; TPH Area ASWL2 stretched from catch basin U19 to catch basin U27. All of the catch basins, the asphalt swale, and underground storm drain pipe were removed during excavation of the petroleum-contaminated soil along these storm water conveyance structures.

TPH Area J (SS-211). TPH Area J was planned as a small area centered around RI sampling location SS-211. The area was excavated as planned. As noted above, petroleum contamination was found to extend laterally along the adjacent storm drain line. Therefore, Area J was incorporated into new TPH Area ASWL1 for subsequent gridding and performance sampling.

TPH Area T. Per the CMP, only a small area of this basin (3716/3717) was identified for excavation. To confirm previous investigation findings in this basin, 12 test pits were excavated in March and April 2003 to depths of approximately 8 to 15 feet bgs. Progress samples were collected from all of the test pits (see Drawing B-1 in Appendix B for test pit locations and sampling results). No odors or visible indications of petroleum were detected, except at 1 foot bgs in test pit TP1, where the bedding material around an exposed drain pipe had a slight petroleum odor. Samples collected at 1 foot and 5 feet bgs in TP1 were non-detect for TPH in all ranges. Slight hydrocarbon-like odors were detected near the surface at TP11 and TP12, and between 5 and 10 feet bgs in TP-12. Progress samples were collected at 2, 5, 10 and 15 feet in TP11 and at 5, 9 and 15 feet bgs in TP12. Results were non-detect for TPH in all ranges.

The 1-foot bgs sample from TP5 contained DRO and HO concentrations of 21.6 and 72.1 mg/kg, respectively. The 2-foot bgs sample in TP8 contained 13.8 mg/kg DRO. No action was taken because these concentrations were well below CULs and ALs.

Petroleum odors were noted between 2.5 and 6 feet bgs in TP9. TP9 was located near the former pipe connections to the western side of tank 3717. Four progress samples were collected with depth in TP9. Results were non-detect for TPH in all ranges except for the 2- and 3.5-foot samples, where GRO, DRO and HO were detected in concentrations up to 304 mg/kg. All detections were below the TPH CULs; however, a 4-foot-deep trench was excavated around TP9 for additional investigation. Based on sheen testing results and field observations, only a small pocket of contaminated soil was observed off the southwest side of the test pit. A progress sample was collected from this area at 2 feet bgs. GRO, DRO and HO were detected at concentrations of 149, 66 and 30.9 mg/kg, respectively. Soil was removed from an area of approximately 10 feet by 20 feet off of the west side of the test pit (including the area of the progress sample) to a depth of approximately 3 feet. Two additional progress samples were collected from the excavation floor and the results were less than 30 mg/kg TPH. After extensive sheen testing of the soil, TP9 was backfilled.

Based on the 12 additional test pits and the associated progress samples, sheen tests, and field observations, no further TPH excavations (beyond the Area T excavation) were performed in this basin.

New TPH Area U. Soil contamination in TPH Area P (basin 2912) was shallow; however, progress samples collected along the western berm edge were above Unocal ALs. Several test pits were then excavated and sampled in the area beyond the basin berm to the west (in a former pipeline corridor) to determine if the contamination along the western berm might be associated with this former pipeline area. Sample results indicated that the area west of the berm was contaminated at depths of approximately 2 to 6 feet bgs. Given these findings, the western boundary of basin 2912 was set and performance samples were collected. A new TPH Area (Area U) was established along a section of former pipeline corridor located west of basin 2912, between sampling locations SS-201 (former pipe manifold area) and SS-212 at the top of the hill.

New TPH Area V. Soil contamination in TPH Area Q (basin F410) was found to be shallow but extended into the northeastern berm. Progress samples collected at the easternmost section of the north berm showed TPH concentrations above Unocal ALs; however, additional soil was not removed in this direction as the contractor needed to evaluate potential storm drain modifications on the far side of the berm. The northeast berm area was surveyed so that it could be relocated for future additional excavation, and the balance of the basin was gridded and performance samples were collected in December 2002. In early April 2003, this area of the berm was removed. Contaminated soil extended to and around catch basin U38, which was removed at that time. The area was designated as TPH Area V, and performance samples were collected in accordance with CMP procedures.

Basin 3716/3717. Fewer TPH performance samples were collected in the Tank 3716/3717 basin than in most of the other TPH excavation areas. The ultimate location of performance sampling points was not based on a requirement to have a uniform distribution of sampling points across the upper yard, but rather reflected the results of comprehensive, basin-by-basin assessment work. The basis for the soil removal in the 3716/3717 basin was described in the CMP approved by Ecology prior to the start of the upper yard interim action. The excavation and performance sampling were conducted based on historical information about the basin (such as whether any releases were known to occur), knowledge of the types of problems typically encountered at sites such as this one (for example, contamination at piping elbows and junctions), and soil sample analytical data.

Soil samples were collected prior to the start of the upper yard excavation from seven test pits, two soil borings, and two 50-foot-long test trenches. Additional soil samples were collected from 12 test pits during the excavation activities to help direct construction activities. Consequently, a total of 77 soil samples from 23 locations were analyzed in a basin approximately 80,000 square feet in size. These sample locations are shown on Figure B-1. The soil sample analytical results showed that there was no evidence of a significant release in the basin.

The 3716/3717 basin was used for soil stockpiling and equipment staging during the excavation activities. After removal of the soil stockpiles and equipment, MFA confirmed that potentially TPH-impacted soil had been removed from the basin using several methods. First, approximately 3 to 6 inches of soil was scraped off the entire 3716/3717 basin floor and hauled off-site, to remove any residual stockpiled soil and expose a fresh ground surface. During the surface scraping, MFA field screened the soil remaining in place using a combination of visual and olfactory observations, PID readings, and sheen testing. Any soil that appeared to have TPH impacts based on field screening was removed. Sheen testing of in-place soil was performed on an on-going basis after scraping.

Second, three progress samples were collected from the area where the impacted soil was stockpiled. Finally, field screening observations were recorded for every sample collected during systematic arsenic performance sampling in the basin. Over 30 arsenic samples were collected at 40-foot intervals across the floor of the entire 3716/3717 basin. Field screening indicated that no petroleum contamination was present in surface soil across the basin. The removal of potentially-impacted surface soil, the results of progress sampling, and the lack of any field screening evidence of TPH impacts to the basin floor during two comprehensive rounds of field screening indicated that TPH-impacted soil was not present on the 3716/3717 basin floor subsequent to use of the basin as a stockpiling and staging area.

Subsurface Structures. Subsurface structures in the upper yard consist of electrical lines, water lines, foam lines (for fire suppression), storm drain lines, and catch basins. The storm drain system consists of a series of catch basins connected by underground concrete pipes. These underground structures are typically located within approximately 3 feet of the ground surface. In addition, a French drain exists along the southern boundary of the upper yard from the Tank 263 basin to the Tank 3717 basin (construction drawings are not available); a branch of the French drain extending downhill between the Tank 2605 and Tank 2911 basins was overexcavated during the upper yard interim action.

When a subsurface structure was encountered, the soil near the structure was screened for the presence of petroleum-impacted soil. If screening indicated the presence of petroleum-impacted soil, the impacted soil was overexcavated until clean soil was encountered. Catch basins and the associated outflow piping, in particular, were evaluated in each tank basin as the excavations typically incorporated the catch basin vicinity. Where catch basins were not overexcavated, a test pit was advanced adjacent to the catch basin to evaluate soil quality. If the soil sample analytical results from a test pit indicated the presence of contaminant concentrations above MTCA Method B cleanup levels, the catch basin and the impacted soil were removed. As noted above, the lower branch of the French drain was overexcavated as part of TPH Area K. The uphill portion of the French drain is reportedly located upgradient of any known contamination sources.

3.7.3 Metals Excavation Areas

At the metals excavation areas, grid spacing (distance between nodes) was typically set at 40 feet or 20 feet and samples were collected at the grid nodes. For elongated areas (linear areas such as under a former pipeline corridor), a standard grid was not established. Alternatively, approximately one third of the samples were collected in the excavation and one third collected on each side of the excavation. The sampling interval was the soil surface to approximately 0.5 feet below the soil surface. Noteworthy information about specific areas is provided below.

New Metals Area NPL. During the excavation of Area N (basin 2910), residual sandblast grit was found in and around an exposed water line trench that ran along the northeastern perimeter of the basin. Given the irregular shape of the excavation area, a new Metals Area NPL (for Area N pipeline) was established and performance samples were collected following CMP procedures. The Area N basin was also gridded and sampled.

Additional Sampling Between Metals-contaminated Areas. Per the CMP, additional samples were collected from areas between tank basins. Twenty sampling locations were randomly selected in the CMP. Fifteen of these locations (SS-214 through SS-228) were sampled. Five locations were not sampled because they were located in areas that already had been over-excavated.

Two Upper Yard Piping Runs. Performance samples were not collected from two short sections beneath former product piping in the upper yard: 1) the piping run located between the Basin 3716/3717 berm and SS-213, and 2) the area between the "west fork" of Metals Area 6C and SS-212. The product piping immediately north of Tank 3716 passed under the Basin 3716/3717 berm. Since underground piping would not have been sandblasted, metals contamination was not a concern and thus the area did not need to be assessed. This stretch of piping was less than 10 feet long, much less than the 40-foot spacing used for typical metals sampling areas in the upper yard.

Almost all of the area between the "west fork" of Metals Area 6C and SS-212 was overexcavated as part of the Area U TPH excavation. Only one small (less than 10 feet long) stretch of the piping was not excavated (the small area immediately south of the south edge of Area 4). This distance was not sampled because it was well within the 40-foot spacing used for typical metals sampling areas.

Metals Area 3. Metals Area 3, located in the lower yard (at the toe of the upper yard slope), was included in the CMP as part of metals removal activities. However, this area is not part of the upper yard certification, and the work will be conducted as part of a future interim action in the lower yard.

3.7.4 Laboratory Analyses

Per the CMP, the metals samples were submitted to the analytical laboratory for analysis of arsenic. The TPH samples were submitted for analysis of GRO, DRO, HO, BTEX, and PAHs. One sample from each TPH excavation area and from location SS-213 was also analyzed for VPH and EPH. VPH/EPH analyses were ultimately not performed for TPH Areas B, V, T and location SS-213. A VPH/EPH analysis was not performed for Area B or location SS-213 because TPH was not detected in any of the samples. A VPH/EPH sample was not collected from Area V, as this small area was an extension of an area (Area Q) that VPH/EPH results were already obtained. A VPH/EPH sample was not collected from Area T due to the small excavation area (10 feet by 10 feet) and the TPH results (15.6 mg/kg DRO and 71.7 mg/kg HO in one sample). The VPH/EPH analyses were performed to provide data in case a basin-specific CUL had to be developed during remediation. Basin-specific CULs were not needed; therefore, the VPH/EPH data were not used.

3.8 Area Restoration

When performance monitoring results indicated that soil removal was complete in an excavation area, the excavation was backfilled. In general, excavations were backfilled with clean, imported sand. Where standing water was present in an excavation, 2- to 4-inch rock was placed from the bottom of the excavation to the top of the standing water and a geotextile fabric was installed over the rock to provide separation between the rock and the remaining backfill material above it. Up to 2 feet bgs, the backfill was typically compacted to 90% of maximum density and the top 2 feet of backfill was compacted to 95% of maximum density. Measurement was per ASTM Method D698 (standard proctor).

A.A.R. Testing Laboratory, Inc. (A.A.R.) of Redmond, Washington, performed periodic testing to assess the compaction of fill materials placed in the excavation areas. HWA GeoSciences, Inc. (HWA) of Lynnwood, Washington, performed random, third-party compaction tests as part of construction monitoring. These compaction tests were performed in basins 263, 1749, 2604, 2910, 2911, and 2914. The A.A.R. and HWA test reports are provided in Appendix D.

Approximately 83,000 tons of clean imported material were used to backfill the excavations, and to construct, repair, and replace construction entrances and internal haul roads. The majority of the imported material was supplied by Rinker Materials (Rinker). A summary of the imported materials from Rinker is provided in Appendix D. Unocal provided 6,000 cy of additional backfill material that was excavated from a private residence in nearby Woodway, Washington. Wyser Construction provided 800 cy of backfill material that was excavated from a site in Shoreline, Washington. Documentation regarding the sources of the fill material is provided in Appendix D. Weight tickets associated with the imported backfill material are on file at Unocal's office. Additionally, portions of the drainage system that were removed during the excavation work were replaced (drain lines and catch basins).

3.9 Unexpected Conditions and Events

Greater soil volumes were removed from the upper yard than estimated during preparation of the Interim Action Report (work plan) and the Technical Specifications. This was due to highly variable subsurface conditions and contamination present in unanticipated areas. An extended schedule and associated weather-related problems, and storm water and soil management procedures also impacted project implementation. A summary of these conditions is provided in Appendix E.

4 REMOVAL SUMMARY

4.1 Volumes/Areal Extent of Soil Removed

The areal extent of each TPH excavation area was surveyed by Triad Associates. The survey drawing is provided in Appendix C. TPH and metals excavation extents are also displayed on the data figures (see Section 5).

Using the post-excavation field survey data and a 1993 aerial topographic map, Triad Associates estimated that approximately 98,000 banked (in-place) cy of soil and asphalt material were removed from the upper yard basins and swale areas. Documentation for this estimate is provided in Appendix C. Triad did not estimate the non-TPH excavation areas (e.g., Metals Area 4).

4.2 Amount of TPH-contaminated Soil Transported Off Site

Approximately 94,650 tons of TPH-contaminated soil were received by Rinker Materials for thermal treatment at 6300 Glenwood Avenue, Everett, Washington. Approximately 16,408 tons of TPH-contaminated soil were received for disposal at Waste Management's Olympic View Landfill. The Olympic View Landfill is located at 10015 SW Barney White Road in Port Angeles, Washington. The soil was initially hauled to the Olympic View Landfill; however, due to logistical reasons (large soil volumes and scheduling constraints), Unocal opted to transport the soil to both Rinker Materials and the Olympic View Landfill. Lists of all shipments to Rinker Materials and Waste Management are provided in Appendix F. Weight tickets for these soil shipments are on file at Unocal's office and a set also has been transmitted to Ecology under separate cover. Bills of lading are on file at Wyser Construction's office.

4.3 Amount of Metals-contaminated Soil Transported Off Site

Approximately 7,320 tons of metals-contaminated soil were received for disposal at Waste Management's Olympic View Landfill. Lists of all shipments to Waste Management are provided in Appendix F. Weight tickets for these soil shipments are on file at Unocal's office and a set has also been transmitted to Ecology under separate cover. Bills of lading are on file at Wyser Construction's office.

4.4 Amount of Asphalt/Polyurethane Coating Material Transported Off Site

Approximately 6,000 tons of asphalt/polyurethane coating material and associated soil were transported to the Rinker Materials facility in Everett, Washington, for recycling. Lists of these shipments to Rinker Materials are provided in Appendix F. Weight tickets for these shipments are on file at Unocal's office and a set has also been transmitted to Ecology under separate cover. Bills of lading are on file at Wyser Construction's office.

4.5 Amount of Debris Transported Off Site

A total of 19.4 cy of asbestos-containing pipe were shipped to Rabanco Regional Landfill in Roosevelt, Washington for disposal. The landfill is located at 500 Roosevelt Grade Road. Manifests for these shipments are provided in Appendix F.

Approximately 270 tons of concrete debris were removed from the upper yard. The debris was transported to the Rinker Materials facility in Everett, Washington, for recycling.

5 SAMPLING RESULTS AND COMPLIANCE DEMONSTRATION

Sampling was performed following procedures described in the CMP and in accordance with the SAP. The samples were analyzed and the data were validated per the SAP. Data validation reports and laboratory reports are on file at Unocal's office and a set has also been transmitted to Ecology under separate cover.

Results of extensive performance sampling demonstrated that MTCA Method B CULs were met during the upper yard remedial action. Three areas were excluded from the compliance demonstration for access reasons: the western-most former piping alignment that extended from the lower yard (up the wooded bank) to the upper yard; a section of the centrally-located former piping alignment that extended from the lower yard to the upper yard (ending near the northwest corner of Area L); and sections of the Pine Street easement (see Section 5.4 for additional discussion).

5.1 TPH Excavation Areas

5.1.1 TPH Sampling Results

After final excavation in each area, performance (compliance) soil samples were collected and analyzed as summarized in Section 3.7. GRO, DRO, and HO results for the performance samples are provided for the 23 TPH excavation areas in Tables 5-1 through 5-23. GRO, DRO and HO results are also displayed on Figures 5-1 (figure legend) through 5-25. Data tables for the associated BTEX, PAH, VPH and EPH results are provided in Appendix G. Results for these parameters are not part of the compliance demonstration but are included for the record. In some cases, VPH and EPH results may be provided for samples that were subsequently overexcavated. Corresponding performance sample TPH results for these samples are not presented on Tables 5-1 through 5-24 and Table 5-26, as the overexcavated samples do not represent the final conditions in the excavation area.

5.1.2 Compliance with MTCA Method B TPH CULs

The MTCA Method B TPH CULs for the upper yard were 200 mg/kg GRO, 460 mg/kg DRO, and 2,959 mg/kg (GRO, DRO and HO fractions summed). For each excavation area, the performance sample data were compared directly to the CULs. If all contaminant concentrations were less than or equal to the CULs, the area complied with the CULs [WAC 173-340-740(9)(d)(iii)].

Where grid sampling is performed, Ecology guidance provides statistical procedures for use in determining whether the CUL has been met. Due to the high number of samples with no detectable TPH (>50% of the samples), the statistical procedures require that the upper 95% confidence limit on the true mean soil concentration (UCL95), calculated from the performance sampling data, defaults to the maximum detected TPH concentration. In practice, this meant that the compliance demonstration was based on a comparison of each sample result to the CULs rather than use of a UCL95 value.

All 842 TPH performance samples met the Method B CULs by direct comparison. The point of compliance was met in all cases. Noteworthy information about specific areas is provided below.

RI Sample Location SS-204. Per the CMP, one sample was collected from RI sampling location SS-204, located west of former Tank 1749 (Drawing No. 1). The RI sample results from this location exceeded TPH CULs when collected in 1995. Based on its location (in an asphalt coating area and not associated with a pipeline or tank basin), the observed concentrations were suspected to be due to asphalt rather than petroleum spills or leaks. After the asphalt coating was removed from this basin, the sample location was surveyed in and a new sample (SS-204-0) was collected and analyzed for BTEX, GRO, DRO, HO, and PAHs. Sample results are provided in Tables 5-24 and 5-25. The results for sample SS-204-0 and field observations demonstrated that the 1995 sample results were due to the asphalt coating and the area did not require additional sampling or excavation.

RI Sample Locations SS-202, SS-209, SS-213. Certain metals sampling areas were also associated with surficial TPH contamination, as shown by samples collected during the RI. Per the CMP, the RI samples collected from certain metals excavation and sampling areas were also analyzed for GRO, DRO, HO, BTEX, and PAHs. Locations SS-202 and SS-209 in Metals Area 2, and location SS-213 in Metals Area 6C were analyzed for GRO, DRO, HO, BTEX, and PAHs. Following the removal of metals-contaminated soil, these RI sample locations were surveyed in and new samples were collected for TPH-related analyses. All results were below the TPH CULs. The sample analytical results are presented in Tables 5-26 and 5-27.

The CMP also called for TPH-related analyses at SS-201, SS-205 and SS-212. These location-specific samples were not collected, as all were located in areas extensively over-excavated for TPH (and subsequently gridded and sampled for GRO, DRO, HO, BTEX and

PAHs). SS-201 and SS-212 were located in TPH Area U and SS-205 was located in TPH Area F.

5.1.3 Compliance with Unocal Action Levels

The Unocal ALs for TPH were 100 mg/kg GRO, 200 mg/kg DRO, and 200 mg/kg HO, for soil located from 0 to 10 feet bgs. The AL for the 10- to 15-foot horizon was 1,000 mg/kg (all fractions summed). Per the CMP, the decision on whether the grid (excavation) area complied with the Unocal AL was to be based on two criteria:

- The average soil concentration, calculated from the sampling data, was less than the AL;
- No single sample concentration was greater than two times the AL.

All but 12 of the 842 TPH performance samples directly met the more conservative Unocal ALs, without averaging the concentrations. One sample result from Area D that slightly exceeded the Unocal AL for GRO was collected below the 15-foot point of compliance (sample D1-B2wall-18, at an estimated concentration of 217 mg/kg GRO). Only in 6 of the 23 TPH areas were average TPH concentrations used to make the demonstration of compliance with the Unocal ALs. The TPH averages for these areas (Areas A, ASWL1, ASWL2, C, D and R) are provided on Tables 5-1, 5-2, 5-3, 5-5, 5-6 and 5-17, respectively. The highest average concentrations were 52.82 mg/kg DRO, 77.33 mg/kg HO, and 9.03 mg/kg GRO. In only one area (Area ASWL2) was a single performance sample concentration greater than two times the Unocal AL. Sample ASWL2-E3WALL-4 contained an HO concentration of 449 mg/kg. The individual sample results met the ALs in all of the other areas.

5.1.4 Areas Eliminated from Further Consideration

Limited areas of the upper yard were eliminated from further remedial consideration during development of the CMP. Areas were eliminated from further consideration based on one or more of the following data sources or conditions:

- Findings of the background history review (EMCON, 1994), including the nature of the operations and corresponding contaminant sources in the upper yard (eliminated areas were located away from bulk storage and transfer of product, releases from tanks and pipelines, and metals contamination associated with sandblasting to remove paint from tanks and pipes);
- Rationale presented in the RI Work Plan (EMCON, 1995), which reflected the findings of the background history report and detailed the areas of the upper yard identified for sampling during the remedial investigation;

- Locations of upper yard operations/equipment (eliminated areas were located away from all tank basins and pipeline corridors);
- Results of the remedial investigation of the upper yard (EMCON, 1998; MFA, 2001a), which indicated that petroleum hydrocarbons were not found in significant concentrations in random upper yard soil borings and that metals were not found in elevated concentrations in subsurface soil;
- Observations of soil conditions following removal of the tanks from the upper yard in 2001, which indicated areas within tank basins that did not appear to be impacted by petroleum hydrocarbons based on surface observations, (MFA, 2001c);
- Sampling data and observations collected during 58 test pit excavations performed in 2001/2002, which identified several areas that contained non-detectable to low petroleum hydrocarbon concentrations in subsurface soil (MFA, 2001c);
- Upper yard topography: Tank basin berms and roadways that were elevated above potential TPH contaminant sources and pathways were eliminated, as the soil in these areas could not be exposed to subsurface contamination. Areas along the southern boundary of the upper yard, which are elevated above the tank basins, were similarly eliminated.

In each of the areas excavated during the upper yard remedial action, the lateral and vertical extents of contamination were removed. The results of additional test pit excavations, over 1,200 progress samples, field observations, sheen testing, and over 800 performance samples collected during this remedial action, substantiated the removals in these areas. An evaluation of the upper yard sampling data and observations, including the effects of subsurface variability in the upper yard and the results of RI and post-RI activities, additional upper yard soil borings and test pits, and interim action progress and performance sampling, indicate that no further excavation in the upper yard is warranted.

5.2 Metals Excavation Areas

5.2.1 Arsenic Sampling Results

Arsenic was identified in the CMP as the indicator hazardous substance for metals contamination associated with the sandblast grit and paint chips. Samples were collected and analyzed as summarized in Section 3.7. Arsenic results are provided for the 21 metals areas in Tables 5-28 through 5-48. Arsenic results and excavation areas are also displayed on Figures 5-26 through 5-45.

5.2.2 Compliance with MTCA Method B Arsenic CUL

The MTCA Method B arsenic CUL for the upper yard was 20 mg/kg. For each metals excavation/sampling area, sample results were compared directly to the CUL. If all arsenic concentrations were less than or equal to 20 mg/kg, the area complied with the CUL.

With the exception of one sample (48.1 mg/kg arsenic) collected in Area N (basin 2910), all 500 metals performance samples met the 20 mg/kg Method B CUL for arsenic and the point of compliance was met. The one exceeding sample was associated with naturally occurring arsenic in the native soil exposed in the "ramp area" of basin 2910. A technical memorandum was prepared and submitted to Ecology documenting background concentrations of arsenic detected in the native soil exposed off the southeast edge of basin 2910 (MFA, 2003). The exposed, native soil in the ramp area measured approximately 20 feet wide by 30 feet long. A copy of the technical memorandum is provided in Appendix H.

5.3 Additional Sampling Between Metals-contaminated Areas

Per the CMP, additional metals samples were collected (0 to 0.5 bgs) from areas between tank basins. Twenty sampling locations were randomly selected in the CMP and 15 of these selected locations were sampled (SS-214 through SS-228). Five locations were not sampled because they occurred in areas that already had been over-excavated. Sample results are provided in Table 5-49; sampling locations and results are displayed on Figure 5-46. All 15 samples contained arsenic concentrations below the CUL.

5.4 Areas Excluded from the Compliance Demonstration

As previously noted, three areas were excluded from the compliance demonstration for access reasons: the western-most former piping alignment that extended from the lower yard (up the wooded bank) to the upper yard; the lower portion of the centrally-located former piping alignment that extended from the lower yard to the upper yard (ending near the northwest corner of Area L); and a section of the Pine Street easement.

Field observations and progress samples confirmed that sandblast grit/elevated arsenic concentrations exists under the rip rap at the top and bottom of the westernmost former pipeline tract, and likely extends its entire length. Due to the severe slope, this area (designated as Excluded Area #1) cannot be remediated using conventional techniques and was set aside for remediation at a future date. Progress sampling and an inspection was then performed along the centrally located former piping alignment that extended from the lower yard to the upper yard (ending near the northwest corner of Area L). Elevated arsenic concentrations were found only in the lower portion of this tract. This area (designated as Excluded Area #2) was also set aside for remediation at a future date.

Petroleum-impacted soil was observed beneath and adjacent to a section of Pine Street during the remedial work in the upper yard. Due to the inability to shut down Pine Street and/or to shore Pine Street to pursue additional excavation or investigation, sections of the Pine Street easement adjacent to basins 2606 and 2605 (designated as Excluded Areas #3A, 3B, and 3C) were set aside for remediation at a future date.

The excluded areas are depicted on Figures 2-1 and 5-47, and on Drawings No.1 and No. 2. Legal descriptions of the excluded areas are provided in Appendix I. Unocal will address these three areas as a separate remedial action and they are excluded from the compliance demonstration.

5.5 Terrestrial Ecological Evaluation

A simplified terrestrial ecological evaluation (TEE) was performed for the upper yard in 2001 (MFA, 2001d). Per the evaluation conclusions and the CMP, no further TEE would be required if the following conditions were met at the conclusion of the upper yard remediation:

- Arsenic was remediated to concentrations at or below 20 mg/kg as Arsenic III within 15 feet bgs;
- TPH was remediated to concentrations at or below 200 mg/kg for GRO and 460 mg/kg for DRO within 15 feet bgs.

As described in the sections above, these conditions were met and no further TEE is required.

6 SUMMARY

The upper yard interim action consisted of the excavation of petroleum-impacted soil and metals-impacted surface soil (containing sand blast grit and paint chips). An asphalt/polyurethane coating material was also removed from the upper yard. This work was primarily performed between July 2002 and May 2003.

Approximately 113,034 tons of petroleum-impacted soil were excavated and transported off site for thermal treatment or disposal. Approximately 7,320 tons of metals-impacted soil were excavated and transported off site for disposal. Approximately 4,021 tons of asphalt/polyurethane coating and the underlying soil were removed and transported off site for recycling. Approximately 83,000 tons of clean imported soil were used to create and replace construction entrances and interior haul roads, and to backfill the excavations.

With the exception of one sample collected in Area N that contained an arsenic concentration of 48.1 mg/kg, all of the 500 metals performance samples met the 20 mg/kg Method B CUL for arsenic, and the point of compliance was met. The one exceeding sample was associated with naturally occurring arsenic in the native soil.

All of the 842 TPH performance samples met the Method B CULs: 200 mg/kg for GRO, 460 mg/kg for DRO, and a combined 2,959 mg/kg for TPH in all ranges (GRO, DRO and HO). All but 12 of the 842 TPH performance samples also met the more conservative Unocal ALs (100 mg/kg for GRO, 200 mg/kg for DRO, and 200 mg/kg for HO), without averaging the concentrations. Only in 6 of the 23 TPH areas were average TPH concentrations used to make the demonstration of compliance with the more conservative Unocal ALs, as prescribed by the CMP. In only one area (Area ASWL2) was a single performance sample concentration greater than two times the Unocal AL. Sample ASWL2-E3WALL-4 contained an HO concentration of 449 mg/kg. The individual sample results met the ALs in all of the other TPH areas in the upper yard.

Three areas of the upper yard were excluded from the compliance demonstration for access reasons. These excluded areas were the westernmost former piping alignment that extended from the lower yard (up the wooded bank) to the upper yard, the lower portion of the centrally located former piping alignment that extended from the lower yard to the upper yard (ending near the northwest corner of Area L), and sections of the Pine Street easement. Unocal will address these three areas as a separate remedial action.

7 PROFESSIONAL ENGINEER'S STATEMENT

As required by WAC 173-340-400 (b)(ii), the opinion of the professional engineer responsible for oversight of the upper yard interim action is provided below. The opinion covers only the work documented in this report and does not include the three areas described in Section 5.4 that will be addressed in the future. In cases where the work deviated from the original specifications due to weather, field modifications, or other reasons, the deviations and their effect on the opinion were considered in the context of whether the remedial action was completed with the original intent of the specifications.

Compliance with specified MTCA Method B CULs was demonstrated per the CMP. One performance sample, collected from Area N, exceeded the arsenic CUL due to naturally occurring arsenic in the native soil.

Based on the results of testing and inspections, it is my opinion that the remedial action was performed in substantial compliance with the plans, specifications, and related documents, as described in this report.

Steven P. Taylor, P.E.

LIMITATIONS

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

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TABLES

FIGURES

DRAWINGS

APPENDIX A

CULTURAL RESOURCE SURVEY

APPENDIX B

SOIL BORING AND TEST PIT DATA

APPENDIX C

YARDAGE ESTIMATE AND POST EXCAVATION SURVEY DRAWING

APPENDIX D

BACKFILL AND COMPACTION DOCUMENTATION

APPENDIX E

UNEXPECTED CONDITIONS AND EVENTS

UNEXPECTED CONDITIONS AND EVENTS

Greater soil volumes were removed from the upper yard than estimated during preparation of the Interim Action Report (work plan) and the Technical Specifications. This was due to highly variable subsurface conditions and contamination that was present in unanticipated areas. An extended schedule and associated weather-related problems, and storm water and soil management procedures also impacted project implementation. A summary of these conditions is presented below.

E.1 Subsurface Variability

The lateral and/or vertical extents of the TPH excavations were greater than the estimated extents in virtually all excavation areas. Excavation of TPH-contaminated soil commenced in the western-most third of the upper yard, where it became evident that subsurface conditions were highly variable. As described in Section 2 of this report, numerous additional test pits were excavated in the central and eastern basins during the remedial action, so as to observe subsurface soil variability in this part of the upper yard and re-assess labor and equipment needs for the balance of the work. Useful information was obtained with these test pits, but subsurface contamination patterns were best discerned after larger areas were excavated.

Small- and large-scale variations in stratigraphy were encountered across the upper yard. The native Transitional Beds, which consist primarily of interlayered silt and sandy silt, frequently contain thin (less than 0.5-inch) laminations distinguishable by variations in color and/or grain size, interbeds and lenses of coarser-grained (generally sandy) material, and areas in which the sandy silt and sand are interlayered very finely to create a horizon that appears “mottled” when excavated. Horizons comprised primarily of stiff, massive to laminated silt are often fractured.

Field observations during the excavation work indicated that the fractures in the stiff silt and the sandy interbeds and lenses commonly created pathways that preferentially transmitted petroleum. In addition, the silt fraction in the “mottled” silt/sand horizons often preferentially contained petroleum. As a result, very small zones of contaminated soil were interspersed among large volumes of clean soil. The clean soil routinely had to be removed to “chase” the small zones of impacted soil.

One example of subsurface variability was TPH Area F (basin 2602/2603/2604). In this area, gray and brown mottled soil horizons were encountered frequently throughout the basin. The mottled horizons consisted of patches of siltier material (gray soil) adjacent to patches of sandier material (brown soil), with the change from silty to sandy soil occurring over 1 to 5 feet laterally and one to several inches vertically. The siltier soil contained TPH concentrations frequently above CULs, while the adjacent sandier soil was typically clean. Because of their proximity, the clean soil was routinely excavated to remove the contaminated soil.

In this same basin, a thin layer of product was found floating on a zone of perched groundwater exposed after the removal of several feet of soil. Sandy soil was exposed in the remainder of the basin, not yet excavated to the same depth. Over a period of weeks, the petroleum in the perched groundwater wicked up through the sandy soil via capillary forces. These patches of petroleum-contaminated soil ranged in size from several inches to 5 feet across, and all were less than 1/16 of an inch in thickness. Large areas of soil were repeatedly scraped to remove the patches.

Multiple phases of over-excavation and sampling occurred in Area F after the patches of petroleum-impacted soil were observed. During this time, between 2 and 8 feet of soil were removed from the floor of the Area F excavation. Several horizons of soil containing perched water were encountered during this work. A trench ranging from approximately 2.5 to 5 feet in depth was excavated and sump pumps were operated to control perched groundwater in the basin. MFA regularly monitored for the presence of floating product on the accumulated water. Discontinuous patches of product sheen were present commonly on the groundwater in the trench subsequent to excavation, but were observed with decreasing frequency as the excavation work continued. Small patches of light product sheen were observed on the water only occasionally during the weeks immediately prior to backfilling. Periodic observations of the water flowing to the storm drain system from Area F subsequent to backfilling did not indicate the presence of petroleum contamination.

MFA also regularly monitored the Area F excavation for the presence of petroleum-impacted patches of soil. Between the completion of the performance sampling in January 2003 and the start of backfilling in February 2003, no petroleum-impacted patches of soil were observed in the floor of the basin. Additionally, no petroleum-impacted patches of soil have been observed in backfill material currently present on the basin floor. MFA performed field screening to check for the presence of petroleum-impacted patches (using visual and olfactory observations and a PID) on August 21, 2003. The screening was performed systematically (screening on approximately 20-foot centers) throughout Area F. No petroleum-impacted patches were present.

In TPH Area SWL, layers of light brown, fractured silt (generally 1- to 3-feet thick) were present between thicker layers of sand and gray silt mixtures in parts of the excavation area. Petroleum-impacted water was present along the fracture zones in the light brown silt, and caused CUL exceedances in soil samples collected within the fractured silt. A large volume of clean overburden soil was excavated in order to remove the thin layers of fractured silt.

Soils in Basin 2606 consisted predominantly of very stiff laminated clayey silt, which normally acts as a permeability barrier to the downward vertical migration of petroleum. However, small fractures with slickensides (small fault zones) were observed in the laminated silt and acted as vertical pathways for the downward movement of petroleum, which accumulated in the fractures, bedding planes, and thin sandy layers in localized areas of the excavation. As these fractures were breached during the course of soil removal work, product dripped slowly into the excavation from the fractures and thin sandy layers over a period of one or more days. Soil in the excavation appeared to be clean and ready for performance sampling, and then patches of product were observed floating on accumulated rain water at the bottom of the excavation the next morning. In order to remove these minor product seeps, the basin was deepened.

In TPH Area B (basin 263), what appeared to be a stress fracture was observed in the silt unit beneath this basin floor. The fracture, which was filled with sandy soil, was approximately 3 inches wide by 12 feet deep, and extended laterally approximately 20 feet with several branches. Petroleum had reached the fracture and spread through its extent.

The examples above illustrate the subsurface variability encountered in the western and central portions of the upper yard. As noted, clean soil was routinely removed in association with the removal of localized seeps, veins, and patches of petroleum or petroleum-impacted soil in these areas. The interlayered silt and sandy silt and the gray and brown mottled soil observed in the western and central upper yard were present in the eastern part of the upper yard. However, in general, the soils exposed during the excavation work in the eastern upper yard were observed to be less variable and more coarse-grained than in the western and central portions of the upper yard.

E.2 Unanticipated Excavation Areas

The swale areas between the tank basins (Area SWL and Area K) were large soil-removal areas. Although soil impacts were known in swale Area K (location of a French drain), the actual extent of the contamination exceeded the anticipated area. A section of the French drain in Area K was unknowingly set in a sandy zone when constructed, resulting in petroleum migration both vertically and laterally over a large area. Contamination in the main swale (Area

SWL) that was uncovered while chasing contamination that emanated from basin 2602/2603/2604, extended into the woods north of the main storm water drainage line.

As previously noted, an asphalt swale existed along the northern edge of the upper yard, beginning at catch basin U13 (located north of the basin 2602/2603/2604 berm) and extending to catch basin U27 (located northeast of basin 2914). The main storm water drainage line serving the upper yard (and to which U13 and U27 were connected) was located directly below this asphalt swale. The asphalt swale tract was not anticipated to be an area of contamination, based on the good condition of the asphalt swale and the lack of detected petroleum in soil samples collected near drainage structures during the RI. Contamination was uncovered beneath the asphalt swale while excavating in Area SWL. While the asphalt swale tract north of basin 2913 was not found to be contaminated, the portion along the base of Area K and along the north side of basin 3392/3393/3394 was heavily contaminated (Areas ASWL1 and ASWL2). In the tract along basin 3392/3393/3394 (ASWL2), the original, corrugated-metal storm drain pipe was overlaid by relatively new, 12-inch plastic pipe. Soil surrounding the newer/shallower line was uncontaminated. The deeper soil along the metal pipe was heavily contaminated and several thousand tons of soil were removed from along the older drainage structure.

E.3 Weather Impacts and Storm Water Management

The tonnage of excavated soil was also greater than estimated due to additional water content, which increased due to excavating contaminated soil in perched groundwater; excavating contaminated soil along established site drainage/utility corridors; soil handling/loading during periods of heavy rain; lack of consistent stockpile coverage (especially small piles in isolated areas); and storm water in soil staging areas and excavation areas. Wet basin floors and excavation bottoms had to be re-scraped several times to remove tracked contamination and/or the effects of cross-contaminated storm water run-on and run-off prior to conducting performance sampling. Removing contaminated soil in the capillary fringe at the top of perched groundwater zones increased both the volume and tonnage of soil removed from several excavations (e.g., Area SWL).

When rain accumulated in the excavation areas, it was routinely mixed in with the soil so it could be removed from the excavation. Although pumps were used to remove large volumes of water from excavations, smaller pockets of water (less than 50 gallons) were commonly mixed in with the soil and removed using the excavator bucket. Wet soil removed from deep excavation areas after impounded water was pumped out was also disposed of as contaminated soil. Excavated soil was typically set on wet ground and picked up additional water each time it was handled. Stockpiled soil was not covered until the end of the work day, and runoff from haul roads and basin berms added a significant volume of water to soil piles. In particular, the basin 263 soil staging area (where the top of the soil pile was just below the level of the haul road) was subjected to runoff from the haul road where trucks dumping soil into the basin left deep ruts.

Wet excavation floors were typically surface-scraped prior to being sampled, and the wet soil was handled as if it was contaminated. In some cases (e.g., TPH Area F), impounded water with a petroleum sheen spread over a wide area of the basin/excavation, requiring soil to be surface-scraped from the basin/excavation floor before sampling could be performed.

The excavation of TPH-contaminated soil in Area B (basin 263) began while the basin was still in use as a staging/stockpiling area. During rain events, stockpiled soil in the basin leached water with a petroleum sheen over the rest of the basin floor. With no outlet for the water (the storm drain system no longer functioned), the petroleum-impacted water contaminated the surface soil. The basin floor required scraping in order to remove the contaminated surface soil.

E.4 Soil Management

In several excavations where direct access to trucks was not practical (e.g., the northern extents of Areas SWL, ASLW1 and ASWL2), clean overburden soil and underlying TPH-contaminated soil were stockpiled together and transferred via trackhoe bucket to areas where it could be loaded into trucks. In order for stockpiling of relatively small amounts (i.e., less than 50 cubic yards) of clean soil to have been considered practical, the soil needed to be placed in a location where it would not be in the way of further excavation work. In some cases, this more than doubled the volume of soil that would normally have been removed from the excavations if the clean soil could have been segregated and stockpiled onsite for re-use.

In other areas, contaminated soil was relayed out of the excavation area by using multiple excavators. Soil was excavated and set outside the excavation area onto clean soil. When picked up by the next excavator, soil underlying the temporary stockpile was removed with it. Clean soil also was cross-contaminated in the staging areas (basin 3716/3717 and 263). The cross-contaminated soil was scraped and excavated out of the basins, adding to the total volume removed from the upper yard.

E.5 Piping with Asbestos-containing Materials

During the removal of the metals-contaminated surface soil, 4-inch-diameter piping made of asbestos containing material (ACM) was uncovered by the contractor in some of the basins.

The contractor retained an ACM removal subcontractor and a notification was submitted to Puget Sound Clean Air Agency. According to Unocal personnel, the piping was used for drain lines. The ACM piping was observed only within tank basins. ACM piping is not expected to be located in non-excavated areas of the upper yard. However, if any additional ACM piping is encountered in the future, it will be appropriately removed.

E.6 Pine Street

During the late February/early March repair of a small section of Pine Street, the contractor observed petroleum-contaminated soil beneath the asphalt pavement. The area being repaired was along the south side of Pine Street. The contamination was noted and left in place. The petroleum may be related to historical road oiling or to some other source. Petroleum was also noted near-surface when the fence posts were removed along the north side of Pine Street, adjacent basin 2606. Evidence of petroleum contamination was also observed along the southeastern excavation wall of Area H (basin 2605), located beneath Pine Street. Additional excavation could not be performed here without undermining the road. The area of observed soil contamination extended approximately 25 feet along the fence line and was approximately 3 to 4 feet deep.

Based on these observations and the inability to shut down Pine Street and/or to shore Pine Street to pursue additional excavation, sections of the Pine Street easement have been excluded from the upper yard remedial action. See Section 5.4 of this report for additional discussion.

APPENDIX F

OFF-SITE SHIPMENTS DOCUMENTATION

APPENDIX G

SUPPLEMENTAL SOIL SAMPLING DATA

APPENDIX H

BACKGROUND ARSENIC TECHNICAL MEMORANDUM

APPENDIX I

LEGAL DESCRIPTION OF EXCLUDED AREAS

EXCLUDED AREAS LEGAL DESCRIPTIONS

EDMONDS TANK FARM
TRIAD JOB NO. 93-253
JUNE 24, 2003
PARCEL DESCRIPTION: AREAS 1 AND 2
UPPER YARD EXCEPTION AREAS

THAT PORTION OF PARCEL B OF CITY OF EDMONDS LOT LINE ADJUSTMENT RECORDED UNDER AUDITOR FILE NUMBER 200202145001, RECORDS OF SNOHOMISH COUNTY, WASHINGTON; SITUATED IN GOVERNMENT LOT 1, SECTION 26, TOWNSHIP 27 NORTH, RANGE 3 EAST, W.M., IN SNOHOMISH COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

A STRIP OF LAND 70.00 FEET IN WIDTH, BEING 35.00 FEET ON EACH SIDE OF THE FOLLOWING DESCRIBED CENTERLINE:

BEGINNING AT THE INTERSECTION OF THE SOUTHEASTERLY MARGIN OF THE BURLINGTON NORTHERN RAILROAD AND THE NORTHWESTERLY BOUNDARY OF SAID PARCEL B;
THENCE NORTH 59°01’17” EAST ALONG SAID BOUNDARY, FOR A DISTANCE OF 176.41 FEET TO THE **TRUE POINT OF BEGINNING** OF SAID CENTERLINE;
THENCE SOUTH 46°06’46” EAST, FOR A DISTANCE OF 130.00 FEET TO THE TERMINUS OF THIS CENTERLINE;

THE SIDELINES OF SAID STRIP TO BE EXTENDED OR SHORTENED TO MEET AT SAID BOUNDARY;

AND ALSO THAT PORTION OF PARCEL B OF CITY OF EDMONDS LOT LINE ADJUSTMENT RECORDED UNDER AUDITOR FILE NUMBER 200202145001, RECORDS OF SNOHOMISH COUNTY, WASHINGTON; SITUATED IN GOVERNMENT LOT 1, SECTION 26, TOWNSHIP 27 NORTH, RANGE 3 EAST, W.M., IN SNOHOMISH COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

A STRIP OF LAND 50.00 FEET IN WIDTH, BEING 25.00 FEET ON EACH SIDE OF THE FOLLOWING DESCRIBED CENTERLINE:

BEGINNING AT THE INTERSECTION OF THE SOUTHEASTERLY MARGIN OF THE BURLINGTON NORTHERN RAILROAD AND THE NORTHWESTERLY BOUNDARY OF SAID PARCEL B;
THENCE NORTH 59°01’17” EAST ALONG SAID BOUNDARY, FOR A DISTANCE OF 688.92 FEET TO THE **TRUE POINT OF BEGINNING** OF SAID CENTERLINE;
THENCE SOUTH 19°34’24” EAST, FOR A DISTANCE OF 78.00 FEET TO THE TERMINUS OF THIS CENTERLINE;

THE SIDELINES OF SAID STRIP TO BE EXTENDED OR SHORTENED TO MEET AT SAID BOUNDARY.

WRITTEN BY: SEB
CHECKED BY: LEC

EDMONDS TANK FARM
TRIAD JOB NO. 93-253
JUNE 24, 2003
PARCEL DESCRIPTION: AREAS 3A, B AND C
UPPER YARD EXCEPTION AREAS

AREA 3A

THAT PORTION OF PARCEL B OF CITY OF EDMONDS LOT LINE ADJUSTMENT RECORDED UNDER AUDITOR FILE NO. 200202145001, RECORDS OF SNOHOMISH COUNTY WASHINGTON AND OF PINE STREET EXTENSION (216^{TH} STREET SW) ADJOINING SAID PARCEL B, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE SOUTHERLY BOUNDARY OF SAID PARCEL B AND THE WESTERLY MARGIN OF SAID PINE STREET EXTENSION;
THENCE NORTH 21°35’00” WEST ALONG SAID WESTERLY MARGIN 109.54 FEET TO A POINT OF CURVE TO THE RIGHT HAVING A RADIUS OF 130.00 FEET;
THENCE NORTHERLY ALONG SAID WESTERLY MARGIN AND CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 61°59’56” AN ARC DISTANCE OF 140.67 FEET TO A POINT OF COMPOUND CURVE TO THE RIGHT HAVING A RADIUS OF 215.00 FEET;
THEN CONTINUING NORTHERLY AND EASTERLY ALONG SAID MARGIN AND CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 16°26’50” AN ARC DISTANCE OF 61.72 FEET TO THE **POINT OF BEGINNING**;
THENCE NORTH 15°46’11” WEST 21.21 FEET;
THENCE NORTH 67°45’50” EAST 18.56 FEET;
THENCE SOUTH 19°30’01” EAST 31.63 FEET;
THENCE SOUTH 63°21’58” WEST 20.88 FEET;
THENCE NORTH 15°46’11” WEST 12.20 FEET TO THE **POINT OF BEGINNING**.

AREA 3B

THAT PORTION OF PINE STREET EXTENSION (216^{TH} STREET SW) ADJOINING PARCEL B OF CITY OF EDMONDS LOT LINE ADJUSTMENT RECORDED UNDER AUDITOR FILE NO. 200202145001, RECORDS OF SNOHOMISH COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE SOUTHERLY BOUNDARY OF SAID PARCEL B AND THE WESTERLY MARGIN OF SAID PINE STREET EXTENSION;

THENCE NORTH 21°35’00” WEST ALONG SAID WESTERLY MARGIN 109.54 FEET TO A POINT OF CURVE TO THE RIGHT HAVING A RADIUS OF 130.00 FEET;

THENCE NORTHERLY ALONG SAID WESTERLY MARGIN AND CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 39°34’49” AN ARC DISTANCE OF 89.80 FEET;

THENCE LEAVING SAID MARGIN SOUTH 57°56’39” EAST 23.98 FEET TO THE **POINT OF BEGINNING**,

THENCE NORTH 31°25’27”EAST 61.15 FEET;

THENCE SOUTH 49°31’39” EAST 11.96 FEET;

THENCE SOUTH 27°55’49” WEST 59.55 FEET;

THENCE NORTH 57°56’39” WEST 15.38 FEET TO THE **POINT OF BEGINNING.**

AREA 3C

THAT PORTION OF PINE STREET EXTENSION (216TH STREET SW) ADJOINING PARCEL B OF CITY OF EDMONDS LOT LINE ADJUSTMENT RECORDED UNDER AUDITOR FILE NO. 200202145001, RECORDS OF SNOHOMISH COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE SOUTHERLY BOUNDARY OF SAID PARCEL B AND THE WESTERLY MARGIN OF SAID PINE STREET EXTENSION;
THENCE NORTH 21°35’00” WEST ALONG SAID WESTERLY MARGIN 79.74 FEET;
THENCE NORTH 70°53’29” EAST 7.28 FEET TO THE **POINT OF BEGINNING**;
THENCE NORTH 21°25’14” WEST 35.23 FEET;
THENCE NORTH 68°36’40” EAST 9.39 FEET;
THENCE SOUTH 21°01’18” EAST 35.59 FEET;
THENCE SOUTH 70°53’29” WEST 9.15 FEET TO THE **POINT OF BEGINNING.**

WRITTEN BY: LEC
CHECKED BY: LEC